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Assessment of motor vehicle use characteristics in three Indian cities

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ABSTRACT

Estimates of emissions and energy consumption by vehicular fleet in India are not backed by reliable values of parameters, leading to large uncertainties. We report new methods, including primary surveys and secondary data sources, to estimate in-use fleet size, annual mileage (kilometers per year), and fuel efficiency of cars and motorised two-wheelers (MTW) for Delhi, and except fleet size and annual mileage of cars, for Visakhapatnam and Rajkot. We estimated that the official number of registered cars and MTW in Indian cities is more than two times the actual number of in-use vehicles. The private vehicular fleet in India is the youngest, its fuel efficiency one of the highest, and annual kilometers travelled is the lowest, compared to many high-income countries, such as the USA and those in European Union. Along with high renewal rate of fleet, the data suggest that it is possible for India to have one of the most fuel-efficient vehicle fleets in the world in the future, if fuel-efficiency standards and fiscal policies to contain growing dieselization are implemented in the country at the earliest.

Introduction

Of all the cars and motorised two-wheelers (MTW) registered in India since 1950, more than 85% were registered during 1991 through 2011. The official registration numbers indicate that in 2012 there were more than five times as many MTW (115 million) as cars (22 million) (MoRTH, 2012). During the same year, India accounted for 4% of the new passenger car registrations in the world, compared to China's 19% and the USA's 21% (ACEA, 2013), while their share in world's population was 17%, 19% and 5%, respectively.

With the growth of vehicular fleet and its usage, owing to rapidly growing economy, fuel consumption by road transport has also increased considerably. Over the two decades from 1991 to 2011, annual petrol as well as diesel consumption in India increased by more than four times (MoPNG, 2008, 2011). Among these fuels, almost all of petrol and 70% of diesel is consumed by road transport for the year 2012–13 (PPAC, 2013). For year 2007, road transport contributed an estimated 6% of the total greenhouse gas (GHG) emissions in the country (GOI, 2011). Since up to 70% of the total oil consumed in India is imported (Lok Sabha, 2013), this leads to heavy economic burden and vulnerability to international economics.

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In addition to direct economic implications, increase in fuel consumption also has climate change implications. In this context, the issue of fuel efficiency standards of vehicular fleet has been gaining increased attention internationally. Many countries (including the four largest automobile markets – the USA, European Union (EU), China and Japan) have adopted more stringent fuel efficiency standards to promote fuel-efficient vehicles (ICET, 2011), but India has only started the process recently (PIB, 2009). The Government of India has notified fuel efficiency standards for passenger cars, vans and utility vehicles to be implemented from 2016 (GFEI, 2014).

With setting of fuel-efficiency standards for vehicles, there is a need to evaluate their effectiveness in the future. For this, fuel efficiency and the resulting fuel consumption need to be assessed for the current fleet, as a base case. Due to a variety of vehicles using the same fuel, such as in case of diesel, total fuel consumed by each vehicle type cannot be calculated from the fuel-wise total consumption figures reported by Ministry of Petroleum and Natural Gas (MoPNG) every year. Therefore, in order to estimate fuel consumption by different vehicle types, one needs to know three parameters for a given vehicle type – number of in-use vehicles, annual average mileage (kilometers per year), and average fuel efficiency of in-use vehicles (kilometers per litre). These three parameters will be referred to as vehicular use parameters in this paper. In case of multiple fuel types used by a single vehicle type, such as cars using petrol, diesel, and compressed natural gas (CNG), we need additional information of fuel-use distribution among the in-use vehicles. In addition to estimation of fuel consumption, these parameters are crucial inputs for estimating emissions, for instance in ASIF (Activity–Share–Intensity–Factor) methodology (Schipper et al., 2000; Yan et al., 2011). For estimation of vehicular emissions, age is also an important determinant, as exhaust emissions from vehicles increase (Anilovich and Hakkert, 1996) due to aging of catalytic converter and degradation of emissions control systems (Ntziachristos and Samaras, 2000). In addition to deterioration due to aging of fleet, emission factors change significantly over different model years because of frequent implementation of emissions standards starting from early 1990s. Fig. 1 presents the timeline of emission standards for Delhi from 1991 through 2014.

Information regarding vehicle use parameters, fuel-use distribution, as well as age distribution is scarce in India, as a result of which estimates of fuel consumption and vehicular emissions from different vehicle types are also unreliable.

Limitations of available data

The database for total number of vehicles registered in the country is maintained by the Ministry of Road Transport and Highways (MoRTH). However the statistics in this database are reported to be an overestimation of the actual number of on-road and in-use vehicles (GOI, 2003; Mohan et al., 2009). This is because, when the vehicles are retired, their records are not deleted from the database. This is particularly the case for private vehicles as the owners are required to pay a life-time tax at the time of purchase and do not have to register the vehicles annually.

Fuel efficiency values for in-use vehicles are not easily available in India. The Society of Indian Automobile Manufacturers (SIAM) reports fuel efficiency of new MTW as determined by the type approval process. In addition, trade magazines like 'Bike India' also report fuel efficiency values of MTW (Iyer, 2012). For cars, fuel efficiency values of new vehicles reported by manufacturers are published in magazines such as 'Autocar' and 'Overdrive', which also have their respective internet-based portals. To estimate the average fuel efficiency of the newly registered fleet, model-wise fuel efficiency values obtained from the above mentioned sources need to be weighed by the proportions of the models in the new vehicle sales.

The laboratory-based type approval values for fuel efficiency have been reported to be higher than in-use values (Schipper and Tax, 1994; Zachariadis, 2006). A recent study from China (Huo et al., 2011) compares the laboratory and real-world fuel efficiency (expressed as litres per 100 km) of 153 car models with a sample of more than 60,000 vehicles, and found a gap of up to 30%. Similar discrepancies between laboratory and real-world fuel efficiency values have been reported for Europe (ICCT, 2014). The average fuel efficiency of overall in-use fleet is a more complex estimate, as it is dependent on characteristics of vehicle models sold in the past and also needs to account for the deterioration of fuel efficiency that occurs due to usage of vehicle over a period of time. Unlike the new fleet, information for in-use fleet is much more difficult to access and needs to be estimated using user-reported values.

Annual mileage is another major parameter indicating the usage of vehicle for which no sources are available. Based on the type of vehicle and its usage, annual mileage varies significantly. For instance, buses and trucks used for commercial

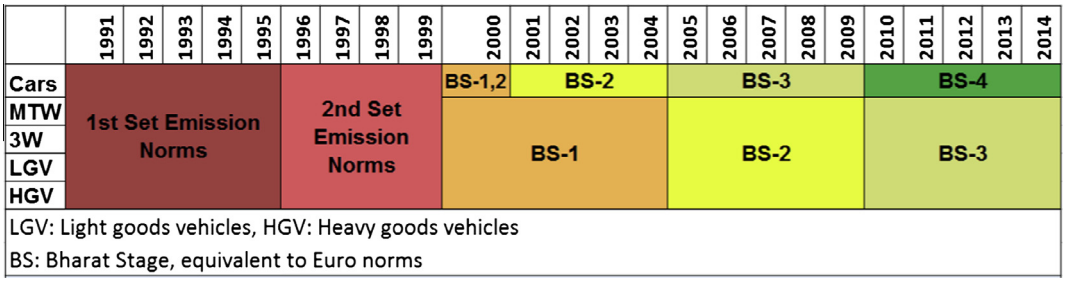

Fig. 1. Timeline of emission standards implemented in Delhi and its neighbouring cities.